FST-601 (QUALITY ASSURANCE)

AIM- To determine the colour of any food material on spectrophotometer and trace the colour of same food on chromatocity diagram by Tritimulus colourimetry.

PRINCIPLE- The colour of any object may be defined comprehensively by measuring the amount of reflection of light from the surface of object at each wavelength band of 380-770mm. This examination is done by Spectrophotometer. In Spectrophotometry, the light band is directed at the sample and the reflected light activates one or more photocells, which transform radiant energy to electrical energy. The electric energy is then transported to milli volt meter, whose reading is shown on LCD. The measurement are made over the entire visible range of Spectrophotometer and a spectrophotometer curve thus obtained characterize the colour of the product. The colour may be reduced to 3 no.s, Therefore a photometric curve may be reduced to 3 no.s which would adequately describe the colour of product. The standard system recommended by CIE consist of 3 primary colour filters X, consist of 3 primary colour filters X,Y and Z. Where X is red in colour, Y is green and Z is Blue.

APPARATUS- Spectrophotometer, cuvettes, beakers, tissue papers etc.

PROCEDURE-

1. SPECTROPHOTOMETRIC DETERMINATION- Switch on the Spectrophotometer, atleast 15 min before determination, so that reading may get stabilized. Then switch on the absorbance mode and set the absorbance zero using 'set zero' knob. Take a clean cuvette and insert it in the place along with blank. Then adjust transmittance to 100 using 'set 100%' knob. Switch on to absorption mode, the absorption here must be zero. If it is not, set it by using 'set zero' knob. Then remove the blank and place the sample cuvette in place and note down the reading of transmittance and absorbance.Take out the sample cuvette and increase the wavelength by 10mm or millimicron. Again put the blank in place and adjust the instrument to 100% transmittance and absorbance, Repeat the procedure for all the wavelength in the visible region. Draw the graph between wavelength and absorption. This will be spectrophotometric curve of the sample.
2. TRITIMULUS COLORIMETERY- The spectophotometeric curve of the sample can be reduced to 3 no.s by average ordinate method, by following procedure-
   a) Determine percentage reflectance at each wavelength, starting with 38nm to 770nm with a wavelength of 10 millimicrons.
   b) At each wavelength, multiply % reflectance for the object with respective values of X,Y,Z depending upon sources of illumination.
   c) Total the product for all the values of X,Y,Z.
   d) Calculate colour co-ordinate x,
      Where x= X/x+Y+Z
      Similarly, calculate y
      Where y= Y/x+Y+Z
      Calculate z, where
      z= Z/x+y+z
      z= 1-(x+y)
   e) The colour of object can be estimated by locating these colour co-ordinates on chromatocity diagram.

AIM - To determine area of irregularly shape food product·

Requirement-sample, graph paper, scale etc.

Theory-size and shape are such an obvious factors of quality control and normally be measured easily by varying the volume measurement, density, curvature etc. area determination is a important method from processing point of view. Area of irregularly shaped food product can be calculated by-

(1)Simpsons method

(2)Average ordinate method

Procedure-(1)Simpsons method-Take food product and draw its external boundary on graph paper. A baseline is drawn at the base of curve. Divide the base line into even no. of parts and measure the length of each ordinate. Add together first and last ordinate and four times the sum of odd ordinates. Multiply the sum with one third the distance between consecutive ordinates.

Area $A_1=1/3a[h_0+4h_1+4h_3+2h_4+4h_3+2h_6+4h_7+h_8]$

This calculated value of area A gives the area between baseline and upper boundary of curve. In order to find out area of curve, it will be necessary to calculate the area of portion between lower boundary of curve and baseline.

$A_2=1/3a[h_0+4h_1'+2h_2'+4h_3'+2h_4'+4h_5'+2h_6'+2h_7'+h_8]$

This area A_2 gives the area between baseline and lower boundary of curve.

Area of curve $A=A_1-A_2$

a=distance between consecutive ordinate.

$h_1h_2h_3$……=length of ordinates from upper boundary of curve to baseline.

$h_1'h_2'h_3'$……=length of ordinate from lower boundary of curve to baseline.

(2)Average ordinate method-divide baseline into any no. of equal parts and at the centre of each part, draw ordinates l_1,l_2,l_3…….Take average length of ordinate and multiply with length of baseline to get area of curve.

Area=Baseline*$(l_1+l_2+l_3+l_4+l_5……l_n)/n$

Aim:- To determine crude fiber content of given fruit and vegetable sample.

Principle:-Crude fiber is the organic residue which remains after the sample has been extracted With petroleum, either,boiling dilute H_2SO_4 and boiling dilute NAOH under standardized conditions. The crude fiber consist of cellulose together with lignin. Crude fiber content is also an important maturity index of fruit and vegetables.

Requirements:- (1)0.255 N H_2SO_4 =dissolve 1.25 gm of H_2SO_4 in 100 ml solution .

(2).0.313 N NAOH=dissolve 1.25 gm of NAOH in 100 ml of solution.

(3). 10% potassium sulphate solution

Requirements:- Digestion flask,silica crucible, weighing balance, filtration cloth etc. Liebig condenser

Procedure:- Extract 2gm of dried material with ether or the wet resudue from crude fat estimation . Transfer the residue and 0.5gm of asbestos to the digestion flask . Add 200 ml of boiling H_2SO_4 solution and connect the digestion flask with condensor. Boil the mixture for at least 30 min . Rotate the flask frequently during boiling, so that sample doesnot sticks to the sides of flask. After 30 min, remove the flask and filter through the filtration cloth. Wash with boiling water until washings are no longer acidic. Now transfer the residue again to the digestion flask and add 200ml boiling NAOH sol. Connect the flask with condenser and reflux for at least 30min. Then remove the flask and immediately filter through the filtration cloth. Wash with water until washings are no longer alkaline . For materials difficult to filter , filter through filtration cloth using vacuum .Then wash the contents with pot. sulphate solution . Potassium sulphate may also be added during filtration to assist in filtration . Then transfer the residue to gooch crucible and wash with boiling water followed by 15 ml alcohol. Dry the crucible at 110 C in oven. Cool in desiccators and weigh . Then transfer the contents of crucible to silica crucible and ignite the contents in muffle furnace for at least 20 min . Cool in desiccators and weigh the loss in weight represent crude fiber content.

General Calculation's:-

Percentage Crude Fiber :- (W1-W2)/weight of sample *100

Where ,W1 :-Weight of residue after moisture removal.

W2 :- Weight of ash after moisture removal.

AIM:- . To estimate the temporary and permanent hardness of water.

PRINCIPLE:-For all the industrial operation,soft water is required because hard water firms residue on heat exchanger plates, which interfere with normal industrial operation. Hard water is a water, which does not form Leather with soap.

Temporary hardness of water is caused by the presence of carbonates and bicarbonates of calcium and magnesium while permanent hardness is due to chlorides and sulphates of calcium and magnesium.

Temporary hardness of water is determined by titrating with sulphuric acid using methyl orange as Indicator.

Permanent hardness is due to chlorides and sulphates of calcium and magnesium and is determined by noting down the volume of standard NaOH or sodium carbonate is required to precipitate these salts present in water.

ESTIMATION OF TEMPORARY HARDNESS:

Apparatus: Hot plate,beaker, titration flask, burette, pipette, etc.

Requirements: 0.02N Sulphuric acid, 0.1N NaoH

PROCEDURE:Titrate 100 ml of water sample with 0.02N sulphuric acid using methyl orange as indicator to faint pink colour.

GENERAL CALCULATION:

1 ml of 0.02N sulphuric acid=0.001gm calcium carbonate

So, temporary hardness = titre*0.001*(10*6)/100

(as calcium carbonate in ppm)

b) ESTIMATION OF PERMANENT HARDNESS:

Apparatus: beaker, hot plate, titration flask, funnel filters, burrete etc.

Reagent required: 0.1N Sulphuric acid, 0.1N NaOH, 0.1N calcium carbonate, methyl orange.

Procedure: Take 100 ml of sample in beaker, boil thoroughly to remove carbon dioxide then add 10 ml each of 0.1N NaOH and 0.1N sodium carbonate.Evaporate till the volume is reduced to 40 ml ,cool and filter and collect the filterate in 100 ml volumetric flask. Washed the residue on filter paper with carbon dioxide free distilled water until water coming out of filter paper is free of alkali. Make the volume and titrate with 0.1N sulphuric acid using methyl orange as indicator.

General calculation:

1 ml of o.1N Sulphuric acid = 0.005gm calcium carbonate

so, Permanent hardness = titre***0.005***(10*6)/100

(as calcium carbonate in ppm)

Aim: - To determine milk quality by estimating its fat percentage, specific gravity, SNF % and TS%.

Apparatus:- Gerber centrifuge, lactometer, hat H2O both maintained at 65°, burettes, pipettes (1ml & 10ml & 10.75ml), lock stopper and butyrometer stand.

Reagents: - (i) 90% H2SO4 having specific gravity 1.814-1.820g/cc at 20°C

(ii) Amyl alcohol having specific gravity 0.803 to 0.805g/cc at 20°C

Procedure:- Take 10ml of 90% H2SO4 in butyrometer, pipette out 10.75ml of will mixed milk sample and transfer to butyrometer along the sides add 1ml 95% amyl alcohol with pipette along sides of butyrometer .Now tighten lock stopper so as to seal mouth of butyrometer and mix content of butyrometer by shaking butyrometer until whole of curd has been dissolved. Keep butyrometer in H2O both uncontained at 65° for 5min. Centrifuge in Gerber centrifuge for 10-15min. Adjust fat column at scale of butyrometer and note down the readings. Warm the sample to 40° and mix the content thoroughly. Cool milk to specific gravity temperature of lactometer calibration. Then pour the milk into long glass cylinder up to the brim in taking care to avoid formation of foam. Insert the lactometer gently into measuring cylinder containing milk. The lactometer should not touch the sides of measuring cylinder to remain steady in the milk. Note down reading of lactometer corresponding to top of meniscus without error of paradox and note down temperature of milk.

General Calculations:-

Specific gravity of milk = $1+\frac{2\ CLR}{1000}$

% SNF = $\frac{CLR}{4}$ + 0.2F +0.14

% TS = $\frac{CLR}{4}$ + 1.2F +0.14

Where F= fat content

CLR= corrected lactometer reading

AIM: Detection of common adulterants in milk.

I. STRACH

- THEORY: Starch is added to milk to made up density to prevent the detection of added water. starch increases the TS %age of milk. presence of starch can be confirmed by addition of iodine to milk sample as starch from blue coloured composed with iodine.
- APPARATUS: I2 soluton,test tube,heating,sources,milk sample.
- PROCEDURE: Take 3ml of milk sample. heat it to boiling temperature. cool it to room temp. and then add 2-3 drops of Iodine solution. the development of blue colour is indication of presences of starch.

II. CANE SUGAR

- THEORY: It is added to milk to raise its density to prevent detection of added water. cane sugar can be estimated by addition of resorcinol because cane sugar gives red colour with resorcinol in acidic conditions.
- REQUIREMENTS: conc.HCl, resorcinol, test tube,h20 bath etc.
- PROCEDURE: Take 10ml of milk sample in a test tube and add 1ml of conc HCl. Mix it thoroughly and add 0.5gm of resorcinol powder.Mix properly and place test tube in H**2**O bath (boiling) for 5 mins and observe the colour development. Development of red colour indicates presence of cane sugar in milk.

III. GLUCOSE

- THEORY: Glucose is added to milk to increase it's bulk density. As glucose is a reducing sugar, it reacts with Fehling's solution and then reduce to cuso4 to red coloured cuprous oxide.
- REQUIREMENTS:Beakers,boiling H_2O bath,Fehlings solution A,B and test tube etc.
- PROCEDURE:Take about 1ml of milk sample in test tube and add 1ml fehling solution A. Heat of red coloured crystal of cuprous oxide confirms the presence of glucose.

IV. UREA

- REQIREMENTS:2% hypochlorite solution,2% NAOH, 0.25%(TCA) Trichloroacetic acid,5% phenol.
- APPARATUS: Boiling water bath, whattman's number 42 filter paper, test tube, funnel, beaker.
- PROCEDURE: Take 10ml of milk sample in a test tube, add 1ml of conc HCl. Mix it thoroughly and add about o.5gm of resorcinol powder properly and place test tube in H2O bath.

AIM- Estimate lycopene content of given tomato product to quantity the colour.

PRINCIPLE-

The red colour of tomato is due to lycopene . Tomatoes contains other tomato, lycopene predominates. Raw green. However contain no lycopene but contain chlorophyll and other carotenoid pigments. It is good index of quality of fruit used in manufacture of tomato at 473 nm. The rapid method of estimation of lycopene based on measurement of petroleum ether extract of tomatoes at 503 nm.

REAGENT REQUIREMENTS-

Acetone , ether, sodium sulphate etc.

APPARATUS REQUIREMENT-

Beaker, pestle and mortar, separating funnel, measuring cylinder, spectrophotometer etc.

PROCEDURE-

Weigh 5-10 gm of juice, ketchup or purre extract with acetone in a pestle and mortal until the residue become colourless. Transfer the acetone extract to a separating funnel, containing 10-15 ml petroleum ether and gently. The carotene pigment can be transferred to petroleum ether layer by diluting acetone acid water. Transfer the lower phase to another separating funnel and petroleum ether extract containing carotenoid pigment to amber colour. Repeat extraction of acetone phase until it become colourless.

Discard the acetone phase . add small quantities of sodium sulphate to petroleum ether extract to 50 ml flask and dilute to the level with petroleum ether . Dilute 5 ml of solution to 15 ml and measure the colour at 503 nm.

GENERAL CALCULATION –

Calculate the lycopene content of sample using the empirical relation that optical density of one 3.1206 micron gram of lycopene per ml .

Mg of lycopene = 3.1206 * OD * volume * dilution * 100/weight of sample * 1000

1000 for conversion of micron to mg.

Aim- To determine the gluten content of flour.

Requirement- flour, water, petriplate, beaker, oven

Theory- Gluten is a protein combination of gluten and glaidin. It is insoluble in water thus gluten can be measured after washing away starch and bran from flour. The flour is kneaded to form dough and gluten is allowed to develop. Then it is washed under a new water to remove starch and finally weighed.

Procedure- weigh flour about 25 gm and knead it with water to form dough ball is then kept in beaker filled with water for 30 mins. The dough ball is then removed from beaker and kept under running water till milkiness is removed nd water runs clear. Iodine solution is used to check the absence of starch is sample by adding drop of cease wash water to iodine solution. Absence of any purple colouration indicates absence of starch.

Weigh wet gluten and spread as sheet in petridish. Allow it dry in petridish in oven at 130c for 1 hr. then final wt of dried is taken.

General calculations-

Wt of flour-w gm

Wt of wet gluten= w1 gm

Wt of dry gluten= w2 gm

%age of wet gluten= w1/w * 100

%age of dry gluten= w2/w3 *100

Aim :- Cut out examination of canned foods.

Requirements :- Canned food product(pineapple slices), Can opener, beaker, weighing balance.

Theory :- Cut out examination of canned product is done to check the quality and the presence of any undesirable matter or change.

During the external and internal examination of can the presence of any undesirable matter or change is noted so as to determine the quality of the can.

Procedure :- External appearance of the can :-

Note down the external appearances of the can body prior to opening. So far as to check the presence of any –

- Body dent
- Scratches
- Leakage from the seal
- Condition of the ends of the can i.e. whether it is flipper or springer or a swell can
- Also note down the wt. of the can
- Batch number
- Brand name
- Manufacturer's name
- Date of expiry from the can

Flat Can: - The ends of the can are flat or concave.

Flipper can: - The flipper can are that in which vacuum is so low that mechanical shock will produce distortion of one or both ends of the can.

Springer can: - A can in which one end is distorted & other end is flat and pressure on the convex end will cause the flat end to spring out when pressed.

Swell can: - A can in which both ends are concave i.e. there is enough pressure to cause the permanent distortion of both ends.

Gross wt. of Can:-

Take the weight of can without opening it and is referred to as the gross wt. of can.

Vacuum of can:-

It can be determined by using a gauge which indicates both pressure and vacuum.

Inside the can pierce the hollow pointed end of the gauge through the lid of can so that the rubber gasket forms an air tight contact with the lid do not press it hard the vacuum is indicated by needle on the dial of gauge. Note down the vacuum in inches.

Appearance of can content:-

Open the can with can opener and note down the appearance of can content. Also note down the filling of the can whether it is overfilled or under-filled or cloudiness in the syrup.

Gross head space:-

It is the distance from the top of the double seal to surface of the can contains.

Drained Weight:-

Empty the content of can in such a manner so as to distribute the products evenly on a circular sieve which allow the drainage of the product.

Net weight of can:-

Take out the weight of the empty can from gross weight of can to get the net weight of can.

Internal condition of can:-

Examine the internal surface of the empty and washed can from the evidence of corrosion defect in

Discolouration leakage then note the condition

Examine the syrup:-

Note down the colour clarity and flavour of the syrup firstly determine the soluble solids in the syrup by using the refractrometer.

If the can contents contain salts i.e. brine then it is determined by titration method using silver nitrate standard sol. & potassium chromate as indicator.

Inspection of food contents:-

- Check the colour of the contents as :-
  Dull
  Bright
  Shiny appearance
- Check blemishes on the dried food contents.
- Check the fruit pieces as soft, pulpy, disintegrated.
- Check the flavour of the can contents, report the flavour as good, acceptable, normal, slight, unacceptable or non-palatable.
- Check the presence of any foreign colour/flavour due to presence of lacquers chlorides.
- Even excessive use of dyes or due to the corrosion of the plates result in metallic taste.

Aim:- To Estimate Alcohol Insoluble Solid's in given vegetable sample.

Principle:- The quality of canned pea's is determined by maturity at the time of harvesting . The maturity is related to Alcohol Insoluble Solid's, which consists mainly of starch, Hemicelluloses, fiber and protein. Tender green pea's have lower AIS value than Mature one's . The generally accepted limit in USA for smooth and wrinkle seeded Variety are 23.5% and 21% respectively. For Grade A pea's , AIS should be 11-16%. In Grade C pea's AIS should not be more than 23.5%

Procedure :- As per AOC method ,

- Grind the pea's in a blender to a smooth homogenous paste .
- Then weigh 20gm of ground material in 600ml beaker.
- Add 300ml of 80% alcohol, stir ,cover the beaker and boil it.
- Simmer slowly for 30 min.
- Now filter through filter paper using vacuum.
- Wash the residue on filter paper with 80% alcohol un till washings are colourless.
- Take out filter paper and dry it in oven for 2 hour's at 100 C.
- Cool in Desiccators and weigh it .

General Calculation:-

Percentage Alcohol Insoluble Solids :- Weight of residues/Weight of sample * 100

AIM:- To estimate the total and free SO_2 content by modified ripper method.

PRINCIPLE:-

SO_2, added to a food product as preservative may exist as undissociated sulphurous acid as free sulphite ions and combine SO_2 in the form of hydroxysulphonates.The available method of analysis are designed to measure either free or total SO_2.Free SO_2 is estimated by direct titration method. In estimation of total SO_2 excess alkali at room temperature subsequent acidification to prevent recombination and then titration with I_2.

APPARATUS:-

Burette, Pipette, Conical flask, Measuring cylinder, etc.

REAGENTS:-

Dilute H2So4 (1:3), Na_2SO_3, 0.02N I_2 solution, Starch indicator, Formaldehyde, 5N NaOH, 5N HCl, etc.

PROCEDURE:-

Part-A Free SO_2**:-**

Acidify 50ml of sample with 5ml dilute H_2SO_4. Expell the air present by addition of 0.5g Na_2CO3 and titrate rapidly with 0.02N standard iodine solution and starch as an indicator. The blue colour should persist for a few minutes, let this value 'a'. To determine the titre due to iodine reducing substances other than SO_2 acidified 50ml of sample with 5ml dilute H_2SO_4

And add 1ml formaldehyde. Allow to stand for 15 minutes and titrate rapidly against I_2 to a blue colour. Let this value 'b'. Volume of I_2 used by free SO_2 is equal to 'a-b'.

Part-B Total So2:- Take 50ml of sample and add 5ml 0.5N NaOH. Stir gently being careful to not to heat air into the solution. Allow the solution to stand for 20 minutes. Then add 7ml 5N HCl followed by 10ml formaldehyde. Allow the sample to stand for 10 minutes. Then titrate the sample immediately against 0.02N Iodine solution using starch as an indicator. Let this volume be 'd'. Amount of I_2 used by total SO_2 is equal to (c-d).

GENERAL CALCULATIONS:-

1ml of 0.02NI2 solution = 0.64 mg SO_2

Free SO_2 (in ppm) = (a-b)*0.64*1000/weight of sample

Total SO_2 (in ppm) = (c-d)*0.64*1000/weight of sample

AIM: TO STUDY DIFFERENT TYPES OF GRAINS GROWN IN INDIA

THOERY: **Grains** are small, hard, dry seeds, with or without attached hulls or fruit layers, harvested for human or animal consumption. The two main types of commercial grain crops are cereals such as wheat and rye, and legumes such as beans and soybeans. The major global commodity markets exist for maize, rice, soybeans, wheat, and other grains but not for tubers, vegetables, or other crops.

WHEAT: Wheat (*Triticum* spp.) is a cereal grain which is now cultivated worldwide. Wheat is a Rabi crop (Crops that are grown in the winter season, from November to April). Wheat kernels or berries vary widely in hardness and color. The color of the bran is usually white or red and sometimes may be purple. Globally, wheat is the leading source of vegetable protein in human food, having a higher protein content than other major cereals, maize (corn) or rice.

Major states in India producing wheat are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh. Other states include Rajasthan, Bihar, Maharashtra, Gujarat, West Bengal, Jammu Kashmir, etc..

Storage:

After harvesting wheat grain storage varies from mud structure to modern bins. Grains can be stored indoors, outdoor or at underground level. Indoor storage involves grain containment in structures like Kanaja, Kothi, Sanduka and earthern pots. Outdoor storage of grains is done in structures made of bamboo or straw mixed with mud. For small-scale storage of grains the PAU bin, Pusa bin and Hapur tekka may be used.

RICE: Rice is the seed of the grass species *Oryza sativa* (Asian rice). As a cereal grain, it is the most widely consumed staple food for a large part of the world's human population, especially in Asia. Rice is a Kharif crop (crops are usually sown with the beginning of the first rains in July, during the south-west monsoon season. A rice grain is made up of an outside husk layer. When the husk is removed, the rice is called brown rice. After undergoing different milling processes brown rice is converted to white polished rice.

The regions cultivating this crop in India is distinguished as the western coastal strip, the eastern coastal strip, covering all the primary deltas, Assam plains and surrounding low hills, foothills and Terai region- along the Himalayas and states like West Bengal, Bihar, eastern Uttar Pradesh, eastern Madhya Pradesh, northern Andhra Pradesh and Orissa.

Storage:

Paddy, as well as rice are stored to maintain the supplies between two harvests. Storage provides protection against weather, moisture, insects, micro-organisms, rats, birds and any type of infestation and contamination. In India, paddy/rice is stored in following manners.

1.Mud-bin 2.Bamboo reed bin 3.Metal drums 4.Gunny bags Made up of jute 5.Improved bins 6. Brick-build godowns 7. Cement plastered bamboo bin 8. CAP (Cover and plinth) storage 9. Silos

MAIZE: Maize (*Zea mays*) known as **corn**, is a large grain plant domesticated by indigenous peoples in prehistoric times. The leafy stalk produces ears which contain the grain, which are seeds called kernels. They are of various colors: blackish, bluish-gray, purple, green, red, white and yellow. Maize kernels are often used in cooking as a starch. Maize is mainly a rainfed kharif crop which is sown just before the onset of monsoon and is harvested after retreat of the monsoon. In Tamil Nadu it is a rabi crop and is sown a few weeks before the onset of winter rainy season in Sept. and Oct .

More than half the maize of India is produced in four states of Madhya Pradesh, Andhra Pradesh, Karnataka and Rajasthan. Andhra Pradesh and Karnataka have emerged as important producers of maize in India. Among the other producers are Jammu and Kashmir, Punjab, Orissa, Chhattisgarh and Jharkhand.

Storage:

Producers store maize in bulk at farm godown or in own house using various types of traditional and improved structures. Such as 1.Mud-bin 2.Bamboo reed bin 3.Metal drums .4.Gunny bags Made up of jute. 5. Improved bins 6. Brick-build godowns 7. Cement plastered bamboo bin 8. CAP (Cover and plinth) storage 9. Silos

PEARL MILLET: Pearl millet (*Pennisetum glaucum*) is the most widely grown type of millet. It is commonly known as 'Bajra'. It is a Kharif crop. India is the largest producer of pearl millet, rajasthan is highest producing state in india. The grains are hard and firm. The fruit is cylindrical, white or pearl in color, or sometimes yellow or brown, and occasionally purple.

Storage:

Pearl millet grain is stored traditionally in mud bins or straw bins or bamboo bins or in metal bins. The storage structures in rural areas are not ideal from scientific-storage point of view, as substantial losses occur during storage of grain from insect pests, moulds, rodents, etc.

PEANUT: The **peanut** or **groundnut** (*Arachis hypogaea*) is a species in the legume or "bean" family. China leads in production of peanuts followed by India and the U.S.A. In India Around 75% of the crop is produced in khariff (June - September) and remaining 25% in rabi (November - March). Around 75% of the crop is produced in khariff (June - September) and remaining 25% in rabi (November - March). Gujarat, Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra are the major producers of Peanuts. The peanut plant produces yellow, orange, cream or white flowers which produce 'pegs', characteristic floral structures which sink into the ground to grow the pod.

Storage

Smallholder farmers store groundnut as pods, in earthen pots, mud bins, bamboo baskets or in other types of receptacles. Such containers are often plastered with mud and cow dung with little or no use of pesticides.

For long-term storage the containers are sealed with mud after the addition of ashes, ground pepper, dried neem leaves or other local herbs to control storage pests.

BARLEY: Barley (*Hordeum vulgare*), a member of the grass family, is a major cereal grain. It is one of the first cultivated grains and is now grown widely. Barley has also been used as animal fodder, as a source of fermentable material for beer and certain distilled beverages, and as a component of various health foods. Barley grains are generally large and have bright light yellow colour. The colour may vary from light yellow to purple, violet, blue and black. Malting of barley grains are the major processing method for the production of alcoholic beverages.

The major states growing barley are U.P., Rajasthan, Punjab, Haryana, M.P., H.P., Bihar, Uttaranchal, Jharkhand and Jammu and Kashmir. It is also grown in small pockets in other states like Chhatisgarh, W.B., Nagaland, Maharashtra, Sikkim and Delhi.

Storage:

Grains are stored in depots made by brick, cement, and wood or earth wells.

AIM: TO STYDY DIFFERENT FUMIGANTS USED IN STORED GRAINS

THEORY: Fumigant is defined as chemicals used in gaseous state sufficient concentration to be lethal to pest organisms at a required temperature and pressure. These are toxic gases used to disinfect the commonly enclosures which is completely gas tight. The purpose of fumigation is to obtain more or less immediate disinfection.

The most commonly used fumigants are:

1. **METHYLE BROMIDE (CH_3Br)** – It is used for the fumigation of food grains, milled products of food grains, oilseeds, dry fruits, spices, animal feed, tobacco and fresh fruits. It is carried out under gas tight conditions and sometimes in chamber at reduced pressure. He dose rate for food grains is 82mg/l for 48 h and 48mg/l for milled products for 24 h.

2. **PHOSPHINE** – It is obtained from aluminium phosphide. It is highly toxic and has cumulative effect. Dose of 2-8mg/l is lethal for man in a very short time. It is widely used as weed fumigant. In India it is used for fumigation of stocks under tight covers @ 2 tablets of 3g/tonne og grains. It is not recommended for use below temperature of 12ºC.

3. **CARBON TETRACHLORIDE (CCl_4)** – It has good penetration power but low toxicity for insects so it is used in combination with other fumigants. The dose of 300-400mg/l for10-14 days under prevalent conditions is recommended.

4. **ETHYLENE DIBROMIDE (C_2H_4Br)** – This chemical is suitable for the use on food grains, fresh fruits and is used as a soil fumigant. For fumigation of grains it is used alone or in combination with ethylene dichloride, carbon tetrachloride and methyl bromide.

5. **ETHYLENE DICHLORIDE ($C_2H_4Cl_2$)** – It is highly flammable so it is rarely used alone. It is used in combination with CCl_4 in ratio of 3:1by volume. It is used @ 320-480mg/l for 72 h and 240-320mg/l for a week.

6. **ETHYLENE OXIDE (C_2H_4O)** – In India it is used on experimental scale. It is an insecticide on a wide variety of food stuff. It is used in vacuum fumigation with carbon dioxide or non flammable halogenated hydrocarbon to provide non explosive conditions @100g/m^3 for 3 h.

7. **HYDROGEN CYANIDE (HCN)** – It is used for the fumigation of dry fruits, food grains, milled products,nuts and tobacco. The source of gas is either liquid in cylinders or reaction products of Na or KCN with K_2SO_4 or CaCN. It is used @8-16mg/l for 24 h.

8. **ACRYLONITRITE** – It is highly flammable and cost limit nits use. It can be used safely for food grains, dry fruits, walnuts and tobacco. It is used @ 16-20mg/l for 24-36h for the fumigation of food grains.

9. **CARBON DISULPHIDE (CS_2)** – For the food grains the recommended dose is 24-32mg/l for 24-36h. It has little use in India. It is used in combination with CCl_4 (40-70%) in mixture at normal dose rate and temperature.

10. **CHLOROPICRIN (CCl_3NO_2)** – It is widely used as soil fumigant and occasionally used for fumigation of food grains. The dosage of 24-30mg/l for 3-4 days. It reacts with components of grains and causes change in proteins. In India it is used as warming gas in methyl bromide in the proportion of2-5%

AIM: To study Primary Insect Pests of stored grains.

THEORY: It has been estimated that between one quarter and one third of the world grain crop is lost each year during storage. Much of this is due to insect attack. In addition, grain which is not lost is severely reduced in quality by insect damage. Many grain pests preferentially eat out grain embryos, thereby reducing the protein content of feed grain and lowering the percentage of seeds which germinate. Some important stored grain pests include the lesser grain borer, rice weevil and rust red flour beetle.

- **Lesser grain borer (*Rhyzopertha dominica*)**
  The lesser grain borer is the most serious pest of stored grain in Western Australia. It is a dark brown cylindrical beetle loosely through the grain. The eggs hatch to produce curved white larvae with brown heads and three pairs of legs. The larvae burrow into slightly damaged grains and eat out the starchy interior. After pupating the adults emerge from the grain, leaving large irregular exit holes. The life cycle takes from three to six weeks depending on the temperature. Adults may live up to two months. The adult lesser grain borers chews grain voraciously causing damage which may facilitate infestation by a secondary pest. It is a strong flyer and may rapidly migrate from infested grain to begin new infestations elsewhere.

- **Granary weevil (*Sitophilus granarius*)**
  When disturbed it sits very still for several minutes. An adult lays up to 450 eggs singly in holes chewed in cereal grains. Each egg hatches into a white, legless larva, which eats the grain from the inside. The larva pupates within the grain and the adult then chews its way out. The exit holes are characteristic signs of weevil damage. The life cycle takes about one month under summer conditions and adults may survive for a further eight months. The granary weevil is a small dark brown-black beetle about 4mm long with a characteristic rostrum (snout) protruding from its head. It has biting mouth parts at the front of the rostrum and two club-like antennae.

- **Rice weevil (*Sitophilus oryzae*)**
  An adult lays up to 450 eggs singly in holes chewed in cereal grains. Each egg hatches into a white, legless larva, which eats the grain from the inside. The larva pupates within the grain and the adult then chews its way out. The exit holes are characteristic signs of weevil damage. The life cycle takes about one month under summer conditions and adults may survive for a further eight months. The rice weevil has four orange-brown areas on the wing cases, and is about 3mm long with a characteristic rostrum (snout) protruding from its head. It has biting mouth parts at the front of the rostrum and two club-like antennae. Unlike the granary weevil, the rice weevil is winged and may occasionally fly.

- **Angoumois grain moth (*Sitotroga cerealella*)**
  The Angoumois moth is yellow-brown with darker markings. Its wingspan is 12-20mm. Females lay up to 250 eggs on or near the surface of stored grain. The eggs hatch into a caterpillar which bores into grain kernels remaining inside until mature. It then eats its way out of the grain, leaving characteristic exit pin holes on the grain surface. Unlike most other moth pests, no surface web is formed. The life cycle may

be completed in as little as five weeks. As well as reducing the weight of grains, Angoumois moth infestations impart an unpleasant smell and taste to the cereal.

AIM: To study the physical properties of rice grain

THEORY: The knowledge of physical properties like shape, size, density and % age impurities of grains helps to determine the quality of grains and is also important for designing various handling, separating, drying and storage devices. The various physical properties of rice grains are as follows:-

1) **L/B ratio:** It is the ratio of length to breadth of the given grain which tells the quality of grains as follows:-

TYPE OF GRAINS	**L/B ratio**
Poor quality grains	Below 2.5
Fine quality grains	2.5-3.0
Superior quality grains	More than 3.0

Procedure:
*Select 10 grains and arrange them lengthwise.
*Measure the length of 10 grains and calculate the average length of 1 grain.
*Then arrange the 10 grains width wise & calculate the average width of 1 grain.
*Calculate L/B ratio.

2)**1000 Kernel weight**: It is an important property of rice grain which is related to endospermal content of the grain. More is the 1000 kernel weight, better is the quality of the grains.

Procedure:
*Count 100 grains of rice.
*Take their weight and express it in grains.

3) **Hectolitre Weight**: It is the measurement of the weight of 1 litre grains X 100. It is related to the endospermal content of rice grains.

Procedure:
Fill the measuring cylinder with wheat grains along with gentle tapping and note down the weight of the grains using weighting balance and express hectolitre weight as:
HECTOLITRE WEIGHT= WEIGHT OF 1 LITREGRAINS X 100.

4)**Bulk density:** It is represented by mass per unit volume. It tells about the space required by the grains to settle in a particular area. it also indicates the quality of rice into grains.

Procedure:
*Take a measuring cylinder of a known value.
*Fill it with upto the mark.
*Take the weight of grains in cylinder and calculate the bulk density.
BULK DESNITY (g/cm3)= MASS / VOLUME

5) **Angle of repose**: It is the angle b/w the lease and slope of cone formed due to the free vertical fall of grains on a horizontal plane. It helps in pouring of grains out of storage bins. It also tells about the angle maintained in storage bins so that grains can be easily taken out from the bins.

Procedure:
Weight 100g of rice grains free from impurities. Allow the free fall of the grains taken in container and measure the angle formed b/w the top and lease of heap of the grains. The angle of represented in degrees.

6)**%age of impurities**: It is the amount of impurities present in the grains per 100 parts of the grains. The wheat grains are checked for shrivelled, broken, weeviled, damaged & grains having dust and metal particles.
The various types of impurities present in rice grains are as follows:

- Exatraneous matter: It includes organic matter like straw, weeds, leaves, rodent excreta, other cereals and inorganic matter like dust, dirt or metal pieces.

- Damaged or discoloured rice: Any kind of damaged or discoloured rice other than the normal rice may be considered as an impurity.

- Added mixtures: It is the presence of inferior quality of rice within the superior quality rice.

- Shrivelled grains: These are the grains which are not fully developed.

- Chalky grains: Grains having one or more of the body milky with appearance.

- Weevilled grains: These are the grains which are partially or whole is attacked by weevils.

- Red kernels: These are the grains where 1/4th or more of the surface of grain is coated with red bran.

- Broken or fragmented grains: These include those grains whose length is less than 3/4th of the normal grains.

AIM: To study Secondary Insect Pests of stored grains.

THEORY: The secondary insect pests of stored grains are following:

Rust-red flour beetle (*Tribolium castaneum*)

The rust-red flour beetle is frequently found on farms in Western Australia. It is a reddish brown beetle about 3mm long. The final three segments of its antennae are greatly enlarged to form a club shape. Young adults are pale brown in colour becoming darker with age. Females lay up to 1000 eggs loosely scattered throughout infested grain. Cream-coloured larvae with biting mouth parts and three pairs of legs hatch and remain free from the grain, feeding on cereal dust and damaged grains. A generation takes about one month to complete under summer conditions, but longer in cold weather. Adults may live up to a year. The adult is winged and may fly.

Confused flour beetle (*Tribolium confusum*)

The confused flour beetle closely resembles the rust-red flour beetle in appearance and life history except for the antenna segments which do not have a distinct three-segmented club at the end. It is more often found in flour mills than on farms, as it prefers more finely divided materials.

Saw-toothed grain beetle (*Oryzaephilus surinamensis*)

The saw-toothed grain beetle is common on Western Australian farms. Adults are dark brown to black with six tooth-like projections on each side of the thorax. They lay up to 500 eggs loosely spread through the infested grain; eggs hatch to produce larvae which feed externally on grain dust and sometimes wheat embryos. The mature larvae pupate within a silken cocoon. A complete generation may take place in as little as three weeks but the adults may live up to nine months. They frequently hide in cracks and crevices of buildings and machinery.

Flat grain beetle (*Cryptolestes *spp.)

Flat grain beetles are small reddish brown insects about 1.5mm long with long antennae and a flattened body. Eggs are laid throughout the stored grain and develop into tiny larvae with characteristic tail horns, biting mouth parts and three pairs of legs. They feed on damaged grain and wheat embryos. Pupation takes place in a cocoon. A complete life cycle takes from 4-5 weeks and adults may survive up to one year.

Warehouse moth (*Ephestia *spp.)

The warehouse moth is a drab grey moth with a 10-12mm wingspan. It usually only infests the surface of stored grain. Moths live for only about two weeks, but during that time lay up to 200 eggs. These are distributed loosely on the grain surface. Larvae hatch out of the eggs and wander over the grain surface leaving a trail of silk which may form a thick mat covering the surface of the infested grain. Mature larvae pupate in a silk cocoon among the grain or on the walls of the building. The life cycle takes at least four weeks.

Indian meal moth (*Plodia interpunctella*)

The adult Indian meal moth is grey with distinctive brownish-red tips to the forewings. The female lays up to 200 eggs near the grain surface as it slowly passes from grain to grain spinning a silk thread. Severe infestations may form a surface web on the grain heap. Larvae

attack the wheat germ, then pupate in a cocoon which may be found in cracks and crevices of buildings. The insects quickly emerge as adult moths. A generation takes as little as four weeks under warm conditions.

Warehouse beetle (*Trogoderma variable*)

This beetle was first found in Western Australia in 1989 and that infestation was eradicated. It has now spread to about a dozen locations in Western Australia but has never established to damaging populations.

The warehouse beetle is a pest of stored grain in its own right, but the greater threat is the impact on trade that it could have by masking an incursion of the world's worst pest of stored grain — the khapra beetle. Warehouse beetle and khapra beetle require microscopic examination to distinguish them. Khapra beetle does not occur anywhere in Australia and would have a severe impact on international trade if it became established.

Eggs are usually laid in crevices and under the surface of loose food. They hatch in about a week. Only the larval stage damages grain. It is frequently found in seeds, groceries and used sacks. The larvae are conspicuously hairy. They usually live for about five weeks but may enter a dormant phase (diapause) for more than two years. Larvae may moult up to ten times. After pupation adults emerge. They are less obvious than the larvae and do no damage to grain. They live for up to five weeks during which females lay up to 80 eggs. Warehouse beetles cannot fly and are spread only in infested commodities and old sacks. A characteristic of warehouse beetle infestations is the accumulation of cast larval skins. Hairs shed by larvae may cause asthma, skin or gastric problems. It is impossible to distinguish between *T. variabile* and several harmless native species without the aid of a microscope. Any hairy larvae found in grain stores should be sent at once to the Department of Agriculture and Food, Western Australia for positive identification.

AIM- TO STUDY PHYSICAL PROPERTIES OF WHEAT GRAIN.

REQUIREMENTS- Weighing balance, Measuring cylinder, Beaker, protractor.

THEORY—Physical properties like weight, size and density are an important criteria to determine the quality of wheat. The physical properties also help in designing various handling and storage devices.

The various properties of wheat grain are---

1. **1000 KERNEL WEIGHT**--- It is an important property which is related to the endosperm content of the grain. The grain weight is affected by the size and density of the kernel. The diseased shrivelled and immature grain will have no grain weight. In case of wheat flour, recovery is directly correlated to grain weight. Endosperm to grain ratio is more in large grain, more will be the weight of 1000 kernel weight and better the quality of grains.

   PROCEDURE – Count 1000 grains of wheat. Take their weight by weighing balance and express the result as Gram per 1000 grains.

2. **HECTOLITRE WEIGHT** – It is again the measurement of weight of wheat grain and this weight is again related to endosperm content.

   PROCEDURE— a) Fill 1L measuring cylinder with wheat grain along with tapping.
   b) Find out the weight of 1L of grain using weighing balance.
   c) Express hectolitre weight as---
   Hectolitre Weight=Weight of 1L grains*1000

3. **BULK DENSITY**— It is defined as mass per unit volume and it gives the idea about the space requirement for a given mass of grain. It also indicates purity of grains, since the presence of light foreign matter reduces grain density.

   PROCEDURE — a) Take a measuring cylinder of known volume.
   b) Fill the cylinder with wheat grain upto the mark of specific volume.
   c) Take the weight of these grains.
   d) Calculate bulk density as—
   Bulk Density = Mass/Volume
   (g/ml)

4. **ANGLE OF REPOSE** – Angle between the space and slope of cone formed due to the free vertical fall of grain to the smooth horizontal surface. It helps in pouring of grains and delivery of grains out from storage place. It is important in construction on

of bulk storage facilities and in the calculation of dimensions of intermediate holding bins of given capacity.
Angle of repose depends upon size shape, density of grain, roughness of grain, surface and height of fall of grains.

PROCEDURE—1. Take about 250g of wheat grains free from impurity. Allow free fall of grains from container to a smooth surface.

2. Measure the angle between the base and slope of cone formed directly from the protractor (D).
3. The angle thus calculated is the angle of repose of the grains.

5. **% IMPURITY** --- It is the amount of impurities present in grain per 100 parts of grain.

The various impurities present in grains are---

a) **Foreign matter**-- It includes the matter like straw, leaves, sand, dirt, clay, metal pieces.
b) **Shrivelled grains** – These are grains which are not fully developed and get shrivelled due to loss of moisture.
c) **Broken** --- It consists of pieces of grains that are less than $3/4^{th}$ size of full grain.
d) **Weeviled grains** – These are partially or wholly bored grains due to the attack of weevils.
e) **Slightly damaged grains** --- It includes the grains with damaged pieces or discoloured grains.
f) **Other food grains** – Any other food grain except wheat will be taken as impurity.

PROCEDURE—a) Take 100g of wheat grains. Separate all impurities from wheat grains. Take the weight of impurities.

b) Calculate % impurity as-- % Impurity = Weight of impurity/ Total grain weight *100

FST 603 FOOD PACKAGING –II

EXPERIMENT NO.1

Aim – To study different types of packaging materials used in food industry

Theory - The main aims of packaging are to keep the food in good condition until it is sold and consumed, and to encourage customers to purchase the product. Correct packaging is essential to achieve both these objectives. Good packaging and presentation encourages consumers to buy products. Foods with a longer expected shelf-life have different needs and may require more sophisticated packaging to protect them against air, light, moisture, and bacteria.

1. Parchment paper—Parchment paper is made from acid-treated pulp (passed through a sulfuric acid bath). The acid modifies the cellulose to make it smoother and impervious to water and oil, which adds some wet strength. It does not provide a good barrier to air and moisture, is not heat sealable, and is used to package fats such as butter, lard and is frequently used for box lining and for platforms of confectionery bars inside glass line wraps

2. Wax paper – Almost any paper can be coated or impregnated with wax. It may be dry waxed or wet waxed, later gives more protection than former one. The purified wax, odourless, tasteless and non-toxic can be used , it can be heat sealed. Wax paper is widely used for packaging for packaging of moisture sensitive food products. It also acts as primary package for some candies.

3. Low-density polythene (LDPE) - Heat sealable, inert, odour-free, and shrinks when heated. It is a good moisture barrier, but has relatively high gas permeability, sensitivity to oils, and poor odour resistance. It is less expensive than most films and is therefore widely used. It is used in packaging of chocolate and confectionery. It has found numerous uses in bags for hard candies, outer envelope for cartons of confectionery and coating of carton board.

4. High-density polythene (HDPE) - Stronger, thicker, less flexible, and more brittle than low-density polythene. It has lower permeability to gases and moisture. It has a higher softening temperature (121°C) and can therefore be heat sterilized.

5. Glassine & Greaseproof paper - A translucent sulphite paper that is given a high gloss surface by the heated rollers used in its manufacture. The gloss makes it more resistant to water when it is dry, but if the paper does become wet it loses this resistance. Made by beating fibres more thoroughly during the manufacture of Made by beating fibres more thoroughly during the manufacture of is more resistant to oils. It is extensively used for biscuits, cooking fats, fast foods and baked goods.

6. Tissue paper – It is a thin and weak sulphite paper. It is often machine glazed on one side (known as MG tissue). A special type of tissue paper with small regular perforations is used to make tea bags. These are generally machine finished and process involves

production of smooth, glazed side and rough back side. It is used as protective layer and it prevents movement of articles and confectionery items inside a box.

7. Metal foil - Aluminum foil is made by rolling pure aluminum metal into very thin sheets. Moreover, aluminum foil is available in a wide range of thicknesses, with thinner foils used to wrap food and thicker foils used for trays. Like all aluminum packaging, foil provides an excellent barrier to moisture, air, odors, light, and microorganisms. It is inert to acidic foods and does not require lacquer or other protection. It is widely used for wrapping of chocolate as it primarily comes in contact with them.

8. Polystyrene - Polystyrene, an addition polymer of styrene, is clear, hard, and brittle with a relatively low melting point. It can be mono-extruded, co-extruded with other plastics, injection molded, or foamed to produce a range of products. It is resistant to strong acids and it provide low moisture and gas barrier properties. Typical applications include protective packaging such as egg cartons, containers, disposable plastic silverware, lids, cups, plates, bottles, and food trays. In expanded form, polystyrene is used for nonfood packaging and cushioning, and it can be recycled or incinerated.

9. Corrugated fiberboard (CFB) - Fiberboard can be solid or corrugated. The solid type has an inner white board layer and outer kraft layer and provides good protection against impact and compression. When laminated with plastics or aluminum, solid fiberboard can improve barrier properties and is used to package dry products such as coffee and milk powder. The corrugated type, also known as corrugated board, is made with 2 layers of kraft paper with a central corrugating (or fluting) material. Fiberboard's resistance to impact abrasion and crushing damage makes it widely used for shipping bulk food and case packing of retail food.

EXPERIMENT NO.2

Aim: To check the chemical resistance of various packaging films.

Requirements: Packaging film, 10% Citric Acid Solution, 0.1 N NaOH, Hydrogen peroxide, 1 % Salt Solution, Vegetable oil.

Principle: Chemical resistance of various packaging films is checked so as to see the compatibility of packaging film with different chemicals. The inert gas packaging film will not show any loss or gain in weight in different chemical solutions.

Procedure:

1. Prepare different chemical solutions in different beakers and label them.
2. Cut the strips of various packaging films and note down their initial weight.
3. Dip the strips in beakers containing different chemicals and allow them to remain in the beakers for 1 hour.
4. Remove all the strips from the chemicals after one hour and dry them by pressing between the filter paper.
5. Take the final weight of the strips and note down the gain or loss in weight.

EXPERIMENT NO.3

Aim: To identify various packaging materials.

A) Identification of packaging material on basis of physical and chemical tests

Principle: Different packaging materials have different physical and chemical properties. Various tests can be performed to identify a given packaging material on basis of their chemical and physical properties.

1. Physical tests:

1. Stretch Test: Stretch a given packaging material and note down the observation.
2. Ease of tearing: Tear a given packaging material and note down the observation.
3. Water spread test: Place a drop of water on the packaging material and note down its spreading characteristics.
4. Burning Test: Allow burning of the packaging material on direct flame and note down the observations.

2. Chemical Tests:

1. Copper wire test: Heat the copper wire and touch it to the packaging material and note down its observations.
2. Solubility in acetone: Dip the packaging material in acetone solution and note down the solubility characters.
3. Solubility in Toluene: Dip the packaging material in Toluene solution and note down the solubility characters.

B) Identification of packaging material on basis of melting and odour characteristics:

Melt the given sample by taking it near to the flame and note down its melting behavior and characteristic odour.

EXPERIMENT NO.4

Aim: To determine the grease resistance of a given packaging material by TTT Test (Terpentine transudation time test)

Requirements: Packaging material, Sudan-IV dye, terpentine oil, white sheet, sand, test tube and calcium chloride.

Principle: Grease resistance of a packaging material means resistance against migration of oils and fats. This test is very important for packaging of pure oils and fats and the products containing oils and fats in it. For packaging of these products, a packaging material with excellent grease resistance is required. In TTT Test transudation time is measured and on basis of that the grease resistance of the packaging material is determined.

Preparation of Sudan-IV Dye: The reagent is a red coloured solution which is prepared by adding 1 gm of Sudan-IV dye to 100 ml of terpentine oil and to this mixture 5 gms of anhydrous Calcium Chloride is added. The mixture is shaken well and is allow to stand for 8 hours. This mixture is then filtered and is used as a reagent for the experiment.

Procedure:

1. Take a sample of packaging material and cut it into required dimensions i.e. 10 X 10 cm2.
2. Place the sample on the white sheet.
3. Weigh 5 grams of sand and pour the sand on the packaging material in form of a heap with the help of test tube.
4. Add 1 ml of the Sudan-IV dye reagent on the sand dropwise and care must be taken that the reagent solution should retain on sand and doesn't spread out.
5. Note down the time immediately and observe the appearance of any red stain on the white sheet by moving the sample to different positions after every 30 seconds for the first 2 minutes and after 1 minute for the next 8 minutes and after 3 minutes for the next 30 minutes.
6. The time interval should be noted in seconds and this is called transudation time i.e. the time interval between addition of coloured dye and appearance of red stain.
7. When the result is more than 30 minutes it should be reported as 1800+ seconds.

Intrepretation of result:

The packaging material with low grease resistance will take lesser time to develop a red stain whereas a packaging material with good grease resistance will take more time to develop a red stain or it may not develop a red stain.

EXPERIMENT NO.5

Aim: To determine water vapour transmission rate (WVTR) pf a given packaging material.

Requirements: Anhydrous calcium chloride, NaCl, beakers, dessicator and packaging material.

Principle:
WVTR is the amount of water vapour transmitted per unit area per unit time of a given packaging material under specific conditions of temperature and relative humidity. Unit of WVTR is gm/m2/ 24 hrs. WVTR value can be determined by dish method, Where a beaker is filled with anhydrous calcium chloride dessicant and sealed with given packaging material. After this weighing of the assembly is done and the assembly is exposed to desired conditions of temperature and relative humidity (RH). The gain in weight in grams of the assembly is recorded after every 24 hours and then graph is plotted between ΔG and ΔT where ΔG is gain in weight and ΔT is time interval.
WVTR is calculated by applying the formula:

WVTR= (Slope X 24) / Area
Where,
Area =∏r2
r= radius of the packaging material exposed to the desired conditions of RH & temperature.

Slope = ΔG/ ΔT
WVTR is an important property of packaging materials used for packing of moisture sensitive foods where a packaging material with low or negligible WVTR value is preferred.

Procedure:

1. Clean and dry 100 ml of beaker and fill approximately $3/4^{th}$ of the beaker with anhydrous calcium chloride.
2. Seal the beaker with the given packaging material and note down the weight. Note down the radius and calculate the area of packaging material to be exposed.
3. Transfer the assembly in dessicator where a saturated salt solution of NaCl is taken to provide an environment of 70% RH and a temperature of 27°C.
4. Note down the weight of assembly after every 24 hours and continue the experiment until a nearly constant weight is obtained. Note down the gain in weight in grams from the initial weight.
5. Plot a graph with ΔT (in days) on X-axis and gain in weight (ΔG) on Y-axis. Calculate the slope and the WVTR value by using the formula already discussed above.

EXPERIMENT NO.6

Aim: To determine the sorption isotherm of a given sample of food.

Principle: The sorption isotherm of a food is graphical representation of equilibrium moisture content (EMC) of food as a function of equilibrium relative humidity (ERH) of the air surrounding the food at a particular temperature. It is also called as equilibrium moisture curve. EMC is defined as moisture content of a food in equilibrium with the surrounding conditions. EMC curve is useful to determine whether a food product will gain or loss the moisture under given conditions of temperature and RH. Knowledge of EM curve of food is a requirement for processing, preparation and formulation of food and it also helps in designing a food package.

Procedure:

For plotting sorption isotherm, EMC value of food product is required at a particular temperature.

1. **Moisture content determination:** Take 10 gms of sample in a Petridish and transfer the Petridish containing the sample in a hot air oven at 100°C. Allow evaporation of moisture from food sample for required period of time and note down the final weight of the sample.

   % Moisture content = {(Initial Weight – Final Weight)/ initial weight} X 100

1. **Equilibrium moisture determination:**
   Take weight of sample and divide the sample into different lots of 5-10 grams. Take the sample lots in previously weighed petridishes and expose the petridishes to different relative humidities ranging from 0-90% inside a dessicator. The different RH can be maintained by using saturated salt solution of different salts at particular temperature in the dessicator. Determine the gain or loss in weight of sample after interval of 24 hours till a constant weight is obtained and there is no further gain or loss in weight (EMC).
   Calculate the EMC by applying following formula:

   % EMC= {(S-X)/ S} X 100

   Where,
   S = weight of sample after equilibrium
   X = amount of solids present in the sample.

   X = A-B

   Where,
   A= Initial weight of sample
   B= Moisture content of the sample.

Draw the EMC curve by plotting a graph between EMC & RH obtained at a particular temperature.

Name of Chemical	**%RH**
Ammonium phosphate	92%
Potassium chloride	86.3%
Sodium Chloride	75.2%
Sodium nitrite	63.3%
Sodium bromite	56.3%
Potassium nitrate	47.2%
Magnesium chloride	32.4%
Potassium acetate	22
Lithium chloride	11.1%

FST 604 Spices and Flavour Technology

Aim- Identification of different spices

Theory- According to FPO (Food Product Order) spices are defined as aromatic vegetable substances used as seasoning in the food. In India, 47 varieties of spices are grown and all these spices provide different types of benefits to the human body. The uses of different types of spices are as under:-

1. Cardamom (Elaichi) - It helps to control bad breath & digestive disorders.
2. Red Chilly (Lal Mirchi) - It is anti-oxidant which helps to cope with cholesterol and is also important in burning of calories.
3. Cinnamon (Dal Chini) – It supports natural production of insulin in human body & also reduces blood cholesterol.
4. Clove (Laung) – It is beneficial for checking toothache. It is also helpful in chest pain, fever & digestive problems.
5. Coriander (Dhania) – It is extremely useful for joint ache.
6. Turmeric (Haldi) – it is useful in healing cuts & for skin problems.
7. Black pepper (Kaali mirch) – It is useful in cold, cough, infection & muscle pain.
8. Garlic (Lahsun) – It is used in abdominal pain, high blood pressure, cough, diabetes and vomiting.
9. Fenugreek (Methi) – Fenugreek seed tea is good for increasing breast milk.
10. Curry leaves – It is useful for reducing blood sugar.
11. Mint (Pudina) – It is used to treat gastric infection and diarrhea.

Aim – To determine moisture content of given sample of spices

Theory – It can be determined by evaporating moisture content in oven at given specific temperatures. After and before drying, difference gives moisture content.

Procedure –

1. Take atleast 3 different samples of spices.
2. Take out empty, clean and dry petridish and weigh it.
3. Weigh 4.5 g sample in each petridish and spread evenly.
4. Then weigh the petridish again containing sample.
5. Keep petridish in hot air oven for 2 hours at 105°C.
6. Allow spices to dry and cool down.
7. Weigh petridish sample after drying.
8. Calculate moisture content of given spice sample.

General Calculations –

Weight of sample = 'x' gm

Weight of petridish + sample (before drying) = 'y' gm

Weight of petridish + sample (after drying) = 'z' gm

% moisture content = $\frac{y-z}{x}$ X 100

Aim – Determination of extraneous matter in spices

Requirements – Weighing balance, petriplate, spice sample

Theory – There are about 70 spices out of which 47 are grown in India. Spices can be classified in different ways which include –
1. Pungent spices – pepper, ginger, chillies and mustard
2. Aromatic fruits – Cumin, Cardamom
3. Aromatic bark – Cinnamon
4. Colored spices – Turmeric and saffron

Spices are mostly used as flavoring agent in no. of food products which includes curries, bakery products, pickle, processed meat and beverages. They enhance flavor of food but if these spices contain any type of extraneous matter whether organic or inorganic it will affect the flavor and quality of finished product. Therefore, spices should be properly cleaned before they are used in foods.

Procedure –
1. Mix material thoroughly.
2. Weigh 10 – 20 gm of material depending upon its nature.
3. Handpick the extraneous matter from the sample.
4. Transfer it to dry and clean petridish and weigh it.
5. Difference between initial and final weight will give extraneous matter.

General Calculations –

W_1 = initial weight of sample

W_2 = final weight of sample

% extraneous matter in given spice sample = $\frac{W1-W2}{W1}$ X 100

Aim – Determination of ash content from given sample of spices

Requirements – Weighing balance, silica crucible, muffle furnace, dessicator and spices sample

Theory – Ash content of any food stuff represents inorganic matter that remains after incineration of organic matter. It may not necessary that ash is equal to mineral matter.

Procedure –

1. Weigh 5 gm sample in silica crucible, which was previously dried and weighed.
2. Ignite the samples in crucible on desired flame of burner. Place the crucible containing sample in muffle furnace at temperature of 550°C for 5 hours.
3. After this, place the sample in dessicator for lowering down temperature of crucible.
4. Again note down weight of crucible containing sample and calculate ash content using formula.

General Calculations –

Weight of sample = 'x' gm

Weight of silica crucible sample (before drying) = 'y' gm

Weight of silica crucible sample (after drying) = 'z' gm

% ash content = $\frac{y-z}{x}$ X 100

Aim- Detection of adulterants in different spices.

Theory - Adulteration may be defined as addition or removal substance from food products which decreases quality of food.

1. **BLACK PEPPER**

Common adulterant - Papaya seeds

Procedure - Papaya seeds separated from black pepper as they are shrumken , oval in shape , greenish brown or brownish black in colour.

2. **TURMERIC**

Common adulterant - Artificial color, Dye

Procedure - (a) Take spoon full of turmeric powder in atest tube.
(b) Add few drops of conc. HCL to it.
(c) Appearance of violet colour indicated that turmeric is pure.
(d) However, if there is artifical colour or dye present, there will be development of metallic colour.

3. **RED CHILLI**

Common adulterant - Brick powder

Procedure - (a) Take glass of water and add spoon fuel of red chilli powder in it.
(b) If brick powder is present it will settle to bottom of flask.

4. **SALT**

Common adulterant - Grits and other extraneous matter

Procedure - (a) Dissolve salt in some amount of H_2o.
(b) Pure salt will completely dissolve, where as many sought of extraneous matter will settle to bottom as it deposits.

Aim - Detection of adulterant in different spices.

Theory - Adulteration may be defined as addition or removal of substance from food product which decreases the quality of food.

1. **CLOVES**
Adulterant - Exhausted cloves
Method of Detection - It can be identified by small size shrunken appearance.

2. **MUSTARD SEEDS**
Adulterant - Argemone seeds
Method of Detection - Argemone seeds are grainy and rough surface and black in colour. They can be separated by close examination. Mustard seeds are yellow inside while argemone seed is white inside while pressing.

3. **SUPARI**
Adulterant - Colour saccharin
Procedure - Dissolve water in supari , the saccharin will give very sweet taste.

4. **HING**
Adulterant - Soap or stones
Procedure - 1) Take a beaker and add small amount of water.
2) Put some hing in water and shake it well.
3) The soap, stones if present get settles at the bottom.

Aim - To check the pH of given sample of spices.

Requirements - Spices sample, pH meter, Buffer Solution, and distilled water.

Procedure - 1) Take 50ml of distilled water and add 5gm of sample to prepare 10% of solution each sample.
2) Standardize the pH meter with Buffer solution with pH 4.2.
3) Dip the electrode of pH meter in the sample solution and note down the readings of given samples of spices.

Aim – Organoleptic evaluation of flavor of different sample

Requirements – Tap water, different samples

Theory – Sensory evaluation can be done by means of human testing by sensory organs. It consists of judging the quality of food by the panel of judges. It deals with measuring, analyzing and interpreting the quality that is perceived by senses of light, taste, touch and hearing. By sense of light the characteristics such as transparency, opaque, turbidity, dullness and glossy nature can be perceived. Other sensory organs like nose and mouth are utilized to obtain information of flavor which is detected by different senses of taste, smell and sensation known as mouth feel. The environment is an important factor in judging the flavor.
Water sample is used for rinsing the mouth between different samples. The results are marked on hedonic scale and data is calculated and average reading is used to analyze the answer of overall acceptability of product. the hedonic scale is as follows :-
9 – Excellent
8 – Very good
7 – Moderately good
6 – Good
5 – Fairly good
4 – Fair
3 – Poor
2 – Very poor
1 – Rejected

Procedure –
1. Different samples of fruit juices were used to determine the flavor of fruit.
2. Before checking the flavor, person should rinse his/her mouth with water.

Aim – To detect the purity of saffron by sulphuric diphenyl amine test

Requirements - Sulphuric diphenyl amine (Prepare the solution by adding 0.1gm diphenyl amine in 20 ml of conc. H_2So_4 + 4ml of water), saffron, petridish

Procedure –

1. Take Sulphuric diphenyl amine solution in clean dish.
2. Add small quantity of saffron in it.
3. If the sample is pure it will give blue color which turns brown but blue color may persist in the presence of nitrate.

Aim – To check pungency of spices (Red Chillies)

Requirements – Sample, sucrose, glassware, alcohol

Theory – The substance in chillies that make them spicy is called capsicin and chilli hotness is rated in Scoville Heat Unit (SHU). Scoville heat unit is the measurement of capcisin level. Human sensory taste sample records its heat level samples are then diluted until heat can be too longer detected by taste, this dilution is called SHU. It is the measurement that involves adding sugar solution until one can no longer feel the pungency in the throat.

Procedure –

1. Weigh 1g of chilli sample in 50 ml volumetric flask & make volume 50 ml with alcohol.
2. Shake the contents & stopper the flask.
Allow it to stand for 24hrs with occasional shaking.
3. Then take 5ml of separation in 200ml measuring cylinder & then make volume of 200ml with 5% sugar solution. It will correspond to 200 times dilution.
4. Now prepare serial dilution from 150 – 750 with 5% sugar solution.
5. Mark the flask accordingly & start sensory evaluation.
6. For evaluation take 5ml of sample every time. Swallow this volume & feel pungency in throat.
7. Keep performing sensory evaluation from high dilution level to lower level.
8. Stop sensory evaluation where there is no feeling of pungency in throat.

AIM: PREPARATION OF CHEESE

REQUIREMENTS: Milk, Starter culture, Rennet, Annatto colour, heating source, knife, etc.

THEORY: Cheese usually is a concentred form of two major components in milk, namely Casein, the principle protein and the milkfat. Beside the milk, selected bacteria, milk coagulating agent and NaCl are used for the manufacture of Cheese.

PROCEDURE:

1. *HEATING OF MILK* : Milk was preheated to 35C-40C.
2. *STANDARDIZATION*: Standardization was done to adjust the casein & fat ratio to 0.68-0.70.
3. *PASTEURIZATION:* Milk was pasteurizes at 63ºC for 30 min.
4. *INOCULATION WITH STARTER CULTURE*: Starter culture @ 05-1.0% was inoculated in the pasteurized milk at 30ºC-31ºC.
5. *RIPENING*: Ripening was done at 31C till acidity of 07-0.8% was achieved.
6. *ADDITION OF COLOUR*: Annato colour @30-200 ml/ 100kg of milk was added.
7. *ADDITION OF RENNET*: Rennet was added at the temperature of 21ºC @ 15-25 ml/100 lt of milk. It was kept for coagulation till clean glass rod was obtained after inserting in a coagulum.
8. *CUTTING:* After the completion of coagulation, a solid mass was obtained which was cut by stainless strips or wires of 6mm or 9mm apart (horizontal and vertical cut).
9. *COOKING:* cooking at the temperature of 37ºC-39ºC followed by drainage of whey was done.
10. *CHEDDARING*: It is the special process involved in the production of Cheddar cheese. It involves:
    - ✓ Cutting of cheese to small size accompanied by salting @ 1-2%.
    - ✓ Cut cheese was placed in hoops at 30ºC-32ºC and the pressing and drainage was done.
    - ✓ Drying was done at 10ºC-12ºC for few days followed by curing and storage at 0-10ºC for 2-3 min.
    - ✓ Packaging was done at 5ºC.

AIM: PRODUCTION OF CITRIC ACID BY *Aspergillus niger.*

REQUIREMENTS: Strain of mold, media for reviving the culture, conical flasks, beakers, etc.

THEORY: Citric acid is a weak acid (organic) with formula $C_6H_8O_7$. It is a natural preservative occurring in citrus fruits and others. It gives acidic and sour taste to food and drinks. It is used as a acidifier, flavouring and chelating agent. In modern production of citric acid, cultures of ***Aspergillus niger*** are fed on the glucose containing media. Corn steep liquor, Molasses, hydrolyzed corn starch or other inexpensive sugary solutions are used for its production. The solution is filtered to remove mold and treated with calcium hydroxide to get calcium citrate salt and then citric acid is regenerated by treatment with sulphuric acid. ***Aspergillus niger*** is the widely used culture as it is the most efficient organism for citric acid production. Some molds can even produce butyric acid and tartaric acid.

PROCEDURE:

1. Activated lyophilized culture of *A.niger* in Czapek Yeast Extract (CYA)Agar / broth (CYB).
2. Prepared a solution of media with following ingredients for citric acid production:
   For 1 lt solution-

COMPONENTS	QUANTITY(g)
Sucrose	140
Ammonium nitrate	2.25
Potassium dihydrogen phosphate	1.0
Magnesium sulphate	0.25
Ammonium ferric sulphate	0.1 mg
pH	2.3

3. 100 ml of media was prepared and 10ml of media was poured in 8 flasks each and autoclaved.
4. Inoculated the media with spore suspension of *A.niger* and flask were incubated at 30ºC.
5. After 4 days, 2 flaks were taken out each day, separating the mycelia material out from the flask by forceps and placed them over a funnel containing filter paper.
6. Allowed the culture fluid carried by mat to drained off which got collected in the flask below.
7. Performed the test for the citric acid production by titration method and strength of acid produced was calculated.
8. Dried the mycelia mat until constant weight was obtained.

GENERAL CALCULATIONS:

Normality of Citric acid = N_1V_1 (NaOH) = N_2V_2 (Citric acid)

Strength of acid = Normality x Equivalent weight (64)

AIM: PREPARATION OF DOSA

REQUIREMENTS: white polished rice, black gram dal, grinder, salt,chillies, oil, dosa tawa, etc.

THEORY: Dosa is an Indian fermented food consumed in daily in southern India and other parts of the country as well as its neighbouring countries. It is the breakfast dish in most of the India. It is made by natural fermentation of black gram dal and polished rice. The natural micro flora is responsible for the leavening action on Dosa (batter).The batter made by mixing of the paste of Black gram dal and polished rice. The amount of water required for the preparation of batter varies according to the consistency of batter required. Thin batter is desirable for dosa as compared to thick in Idli .Both the ingredients acts as the substrate for the growth of micro-organisms but Black Gram dal is the major ingredient contributing the micro flora. During fermentation, *Leuconostoc mesenteroide*s grows first in the batter, leavened it and then followed by *Streptococcus faecalis* and finally *Pediococcus cerevisiae*, all of which contributes to the final acidity.

PROCEDURE:

1. White polished rice and black gram dal was washed and soaked separately for 5-10 hrs.
2. Soaked polished rice and black gram dal was drained grinded to a paste in grinder separately.
3. The paste of the two main ingredients was mixed to form a thin batter.
4. Salt was added to the thin batter and was allowed to ferment at 25ºC-30ºC for 14-16 hr in an incubator.
5. After incubation, the batter was quickly spreaded over the dosa tawa and fried.
6. It is served hot with Sambar.

AIM: TO STUDY THE EFFECT OF AERATION ON THE GROWTH OF BACTERIA.

REQUIREMENTS: Spectrophotometer, conical flasks, nutrient media.

THEORY: Bacteria show pronounced difference in growth and activities in aerated and non aerated conditions. This can be demonstrated by the following procedure.

PROCEDURE:

1. Taken glucose trypton yeast extract broth in 6 flasks and was autoclaved.
2. Inoculated the media with *Bacillus subtilis* or any given culture.
3. Placed the 3 flasks in shaking / orbitial incubator at 37C or the temperature optimum for the given culture and placed the remaining 3 flasks in normal incubator at same temperature.
4. Taken the sample from all the flasks after equal interval of time (2-3h) and spectrophometric reading was taken at 600nm.
5. Plotted the graph separately for aerated sample and non aerated samples and difference was observed.

AIM: PREPARATION OF IDLI

REQUIREMENTS: white polished rice, black gram dal, grinder, salt, etc.

THEORY: Idli is an Indian fermented food consumed in daily in southern India and other parts of the country as well as its neighbouring countries. It is the breakfast dish in most of the India. It is made by natural fermentation of black gram dal and polished rice. The natural micro flora is responsible for the leavening action on idli (batter).The batter made by mixing of the paste of Black gram dal and polished rice. The amount of water required for the preparation if batter varies from 1.5–2.2 times the dry weight of the ingredients..Both the ingredients acts as the substrate for the growth of micro-organisms but Black Gram dal is the major ingredient contributing the micro flora. During fermentation, *Leuconostoc mesenteroide*s grows first in the batter, leavened it and then followed by *Streptococcus faecalis* and finally *Pediococcus cerevisiae*, all of which contributes to the final acidity in Idli.

PROCEDURE:

1. White polished rice and black gram dal was washed and soaked separately for 5-10 hrs.
2. Soaked polished rice and black gram dal was drained grinded to a paste in grinder separately.
3. The paste of the two main ingredients was mixed to form a thick batter.
4. The amount of water required to form a thick consistency of batter varies from 1.5-2.2 times the weight of dry ingredients.
5. Salt was added to the thick batter and was allowed to ferment at 25ºC-30ºC for 14-16 hr in an incubator.
6. After incubation, the batter was poured into the small cups of Idli cooker and steamed for 10-15mins.
7. Idli was them served hot with seasonings.

AIM: PREPARATION OF PICKLES.

THEORY : Pickling is the process of preserving, even expanding the lifespan of food by either anaerobic fermentation in brine or immersion in vinegar. The resulting food is called a pickle**.** This procedure gives the food an interesting twist in flavor. Pickles have low pH concentration, which is sufficient to kill most bacteria. Pickling can preserve perishable foods for months. Antimicrobial herbs and spices, such as mustard seed, garlic, cinnamon or cloves, are often added. If the food contains sufficient moisture, pickling brine may be produced simply by adding dry salt. Natural fermentation at room temperature, by lactic acid bacteria, produces the required acidity. Other pickles are made by placing vegetables in vinegar. Unlike the canning process, pickling (which includes fermentation) does not require that the food be completely sterile before it is sealed. The acidity or salinity of the solution, the temperature of fermentation, and the exclusion of oxygen determine which microorganisms dominate, and determine the flavor of the end product.

Pickling with the help of vinegar and oils has been in practice from time immemorial. Pickles are prepared with salt, oil vinegar, mixture of salt, oil, vinegar and spices. There are several kinds of pickles sold in the Indian market. Mango pickle ranks first. Pickles are classified according to the method of their preparation. Vinegar pickles are the most important in foreign countries. Fruit pickles are generally preserved in sweetened and spices vinegar while vegetable pickles are preserved in salt. In India, oil pickles that is pickles which contain some edible oil, are highly popular.

When both salt concentration and temperature are low, *Leuconostoc mesenteroides* dominates, producing a mix of acids, alcohol, and aroma compounds. At higher temperatures *Lactobacillus plantarum* dominates, which produces primarily lactic acid. Many pickles start with *Leuconostoc*, and change to *Lactobacillus* with higher acidity.Traditionally manufactured pickles are source of healthy probiotic microbes, which occur by natural fer mentation in brine, but pickles produced using vinegar are not probiotic.

PROCEDURE:

Preparation of Mango Pickle

1. Select under – ripe full development variety of mango.
2. Wash them in water.
3. Slice them longitudinally slices with a stainless steel knife. Discard the stones.
4. Keep the slices in brine solution of 2-3 percent.
5. Make the following quantity of spices:

Sr.No	Ingredients	Quantity
1	Mango slices	1 kg
2	Common salt powder	120 g
3	Turmeric powder	10 g
4	Cardamom	10 g
5	Red chilly powder	10 g
6	Cumin	10 g
7	Black pepper	10 g

8	Mustard oil	500 ml
9	Asofoetida	2 g
10	Aniseed	10 g

6. Drain off the water and keep the slice in shade for few hours.
7. Heat the oil and cool it.
8. Mix the mango slice with the all the ingredients and with desirable quantity of oil and place them in a glass jar.
9. Keep it in sun for 4-5 days, till the slice turn pale yellow.
10. Pack the pickle in glass or glazed jar and covered with a thin layer of mustard oil.
11. The pickle will be ready in 2-3 weeks.

Preparation of lime pickle

Receipe:

2 dozen medium to large limes quartered (remove seeds if you like)
3/4 cup white rock/sea salt
1/4 cup black rock salt
8 tsps aniseed/fennel seeds roasted and coarsely ground
8 tsps mustard seeds powdered
8 tbsps chilli powder
8 tsps turmeric powder
2 cups mustard oil
2 tsps mustard seeds
1 tsp asafoetida

Method:

1. Sterilise and dry a glass pickling jar.
2. Put the limes into it, cover with the white and black salts and mix well. Cover the jar tightly and keep it out in the sun for 2 weeks
3. The limes turn a pale brown colour in this time.
4. Mix the mustard powder, fennel, chilli and turmeric powders together and add to the limes. Mix thoroughly.
5. In a pan, heat the mustard oil to smoking point and add the mustard seeds. They will splutter. When done add the asafoetida and immediately turn off the fire.
6. Pour this hot oil over the limes and mix everything well.
7. Allow the pickle to 'rest' for a week before eating it.

AIM: PREPARATION OF SAUERKRAUT

REQUIREMENTS: Cabbage, salt, knives, jar, etc.

THEORY: Sauerkraut is the clean, sound product of characteristic flavour obtained by full fermentation, chiefly lactic, of properly prepared and shredded cabbage in the presence of not less than 2% and not more than 3% salt. It contains upon completion of fermentation, not less than 1-1.5% acid, expressed as lactic acid.

Sauerkraut is the product developed under anaerobic conditions. Salt is the major ingredient responsible for the fermentation as it causes water from the cabbage to extrude out from the tissues of the cabbage and act as the substrate for microbial succession. The juice contains the natural flora of the cabbage as well as contaminants from soil and water. At first, different kinds of micro-organisms grow but acid forming soon predominate. *Leuconostoc mesenteroides* is responsible for the acidity upto 1.0% at 2.5% salt concentration. *Lactobacillus plantarum* is known to be the most desirable non gas forming lactobacilli species, responsible for the final acidity of Sauerkraut (1.7%)

PROCEDURE:

1. Fully mature cabbage was taken.
2. The unwanted outer leaves were removed and the rest cabbage was washed thoroughly.
3. The cleaned cabbage was cut into two equal halves and core was removed.
4. The cut cabbage was shredded in the fine shreds of 2.5mm width and 30mm long with the thickness of 0.08-0.16cm with the help of fine sharp knife.
5. Salt at the rate of 2.25-2.5 % was added to the shredded cabbage uniformly.
6. The salted cabbage was then packed tightly in the jar.
7. The upper mouth of the jar was sealed tightly with the cellophane liner to provide anaerobic condition.
8. The weight was added at the top of the jar so that sauerkraut gets pressed.
9. The kraut was incubated at 20ºC-21º
10. C, till desirable acidity was attained (1.5-1.7%).

AIM: PREPARATION OF WINE

REQUIREMENT: Grapes, sugar, Mother culture, Seed culture, refractometer, etc.

THEORY: **Winemaking**, or **vinification**, is the production of wine, starting with selection of the grapes or other produce and ending with bottling the finished wine. Although most wine is made from grapes, it may also be made from other fruit or non-toxic plant material. Winemaking can be divided into two general categories: **still wine production** (without carbonation) and **sparkling wine production** (with carbonation).The science of wine and winemaking is known as **oenology** and the oldest known winemaking operation, estimated to be 8,000 years old, was discovered in Georgia.

Occasionally white wine is made from white grapes this is done by extracting their juice with minimal contact with the grapes' skins. Red wines are either made from red grapes where the juice is allowed to stay in contact with the dark skins long enough to pick up a pinkish colour or by blending red wine and white wine. White and red wines extract little of the tannins contained in the skins.

To start primary fermentation yeast is added to the must for red wine or juice for white wine. During this fermentation, which often takes between one and two weeks, the yeast converts most of the sugars in the grape juice into ethanol (alcohol) and carbon dioxide. The carbon dioxide is lost to the atmosphere. The alcohol content of the wine ranges from 10-12% V/V. The amount of sugar in grape juice must be controlled. In general it should be between 18º-22º B.

PROCEDURE:

Production of seed and mother culture:

1. For preparation of Seed culture sterlizied media (PDB/YPED) was taken in a flask.
2. It was inoculated with wine species (*Saccharomyces cerevisiae* Var.*Ellipsoideus).*
3. It was incubated at 25C for 5 days.
4. For production of Mother culture, the juice of grapes was extracted and filtered.
5. It was inoculated with the Seed culture (5% V/V).
6. The inoculated juice was incubated at 25º-30ºC for 24 hr.

Preparation of Wine:

7. Fully matured Grapes of good quality were selected and crushed and juice was extracted out.
8. The juice was then treated with sulphur dioxide or pasteurized at 71ºC for 15-20 min.
9. Chapatalization was done (adjustment of sugar content 20º-24ºB).
10. The prepared mother culture was added @ 5% V/V to the juice.
11. The juice was incubated at 25ºC for 5 days (primary fermentation) and then racking was done.

12. After racking, the juice was again incubated at 25ºC for 7 days for final or secondary or Malo-Lactic fermentation.
13. The clarified juice is filtered and bottled in the bottles under aseptic conditions.

BIOCHEMISTRY OF WINE MAKING:

During the primary fermentation, the yeast cells feed on the sugars in the must and multiply, producing carbon dioxide gas and alcohol. The temperature during the fermentation affects both the taste of the end product, as well as the speed of the fermentation. For red wines, the temperature is typically 22 to 25 °C, and for white wines 15 to 18 °C. For every gram of sugar that is converted, about half a gram of alcohol is produced, so to achieve a 12% alcohol concentration, the must should contain about 24% sugars. Alcohol of more than 12% can be achieved by using yeast that can withstand high alcohol. Some yeasts can produce 18% alcohol in the wine however extra sugar is added to produce a high alcohol content. During or after the alcoholic fermentation, a secondary, or malolactic fermentation malolactic fermentation can also take place, during which specific strains of bacteria (lactobacter) convert malic acid into the milder lactic acid. This fermentation is often initiated by inoculation with desired bacteria.

During the secondary fermentation and aging process, Malo lactic fermentation occurs when lactic acid bacteria metabolize malic acid and produce lactic acid and carbon dioxide, which takes three to six months. The fermentation continues very slowly. The wine is kept under an airlock to protect the wine from oxidation. Proteins from the grape are broken down and the remaining yeast cells and other fine particles from the grapes are allowed to settle. Potassium bitartrate will also precipitate, a process which can be enhanced by cold stabilization to prevent the appearance of (harmless) tartrate crystals after bottling. The result of these processes is that the originally cloudy wine becomes clear.

AIM: PREPARATION OF YOGURT.

REQUIREMENTS: Starter culture (*Lactobacillus bulgaricus* and *Streptococcus thermophillus*), containers, skim milk powder, defatted milk, etc.

PRINCIPLE: The principle of yogurt preparation id lactic acid fermentation. The micro-organisms involved in the preparation of yogurt are *Lactobacillus bulgaricus* and *Streptococcus thermophillus.* In the yogurt [preparation pre heated milk is taken, then cooled and inoculated with the starter culture @ 2% and incubated for 3 h till coagulated acidity of 0.75% is achieved.

THEORY: Modern method of yogurt manufacture involves the use of whole or defatted milk. The supplementation of milk solid not fat with non fat dry milk is preferred at industrial scale. The milk fat content in the yogurt varies from 1-3.25%. The proposed federal standards defined the product in 3 categories:

1. Yogurt product containing minimum of 3.25% milk fat.
2. Low fat yogurt- contains not less than 0.5% and not more than 2% milk fat.
3. Non fat yogurt- contains less than 0.5% milk fat.

Permitted additives, sweeteners like sugars, permitted colours, stabilizers and fruit pieces can be used in the preparation of yogurt. The desirable acidity at the time of consumption should be 0.8-0.9%.

PROCEDURE:

1. **Preparation of Mother culture/Inoculum:**
   i. Fresh or reconstituted milk was taken and autoclaved for 10-15 min and cooled to 41ºC.
   ii. Then milk was inoculated with 0.2-1.0% inoculum.
   iii. *Streptococcus thermophillus* was incubated at 38ºC and *Lactobacillus bulgaricus* at 43ºC.
   iv. Coagulation time required was 12-18h.
   v. Then it was cooled to 5ºC and stored.
   vi. The transfers should preferably be made daily. A commercial yogurt culture which contains the both micro-organisms should be incubated between 41ºC-43ºC or according to supplier's instruction.

2. **Preparation of bulk starter:**
   i. These were carried in the stainless steel vessel or vats with sufficient capacity so that it should contain 2 parts of starter for every 100 parts of yogurt made.
   ii. The necessary quantity of skim milk was headed to 85ºC-88ºC for 30-45 min and then cooled down to 43ºC.
   iii. The starter was then inoculated preferably with 1% each of the two species which will have marked effect on the flavour and the odour of the finished product.
   iv. Starters were mixed and later were incubated at 41ºC-43ºC until coagulation occurred.

v. Then the bulk culture was cooled to 10ºC and stored at 5ºC if immediately not required.

3. Yogurt preparation:

i. Skim milk powder was added to whole or partially defatted milk tom increase SNF content by 2-3% to a total of approximately 12%. The milk was thoroughly mixe4d with the help of stirrer.

ii. The mixture was heated to 85ºC for 30 min in water bath to prevent cooked flavour and then cooled down to 43ºC.

iii. It was inoculated with 2% starter culture and stirred to ensure proper mixing and was then incubated at 41ºC-42ºC for 3hr till titrable acidity of 0.75-1% was achieved.

iv. Then was placed in refrigerator for setting and cooled to 5ºC within 8h.

v. The product was ready for consumption. The desirable acidity fir the yogurt is 0.8-0.9%.